# THE 1999 BROWN CLOUD PROJECT FOR THE MARICOPA ASSOCIATION OF GOVERNMENTS AREA

**Prepared By:**


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**Portions of the Technical Analysis Were Prepared By:**

**Sonoma Technology, Inc.**

# EXECUTIVE SUMMARY

## ES.1 INTRODUCTION

Many residents of Maricopa County are attracted to the area by the warm winters and the clear air typical of deserts in the western United States. Most of the year, the air is much clearer in Maricopa County than in the eastern United States. However, on calm fall and winter mornings, dark-colored hazes are often observed over the urban parts of Maricopa County. These hazes have come to be known as brown clouds and are of concern among local residents.

The complaints about brown clouds by residents are mostly based on aesthetics. Residents also tend to use the visual quality of the air as a yardstick by which air pollution is measured. They are concerned that brown clouds are unhealthy.

Consequently, the Maricopa Association of Governments (MAG) conducted this study to recommend feasible measures to abate the brown clouds that occur in Maricopa County. The study topics include: 1) background information on brown clouds in western urban areas; 2) brown clouds in Maricopa County; 3) sources of emissions in Maricopa County primarily responsible for brown clouds; and, 4) recommendation of six potential control measures available to decrease the emissions from these sources.

The study was expanded to include the application of source emission profiles measured in a recent study in the Denver area to Maricopa County air quality data. The purpose was to determine if these profiles could reasonably account for air quality conditions in Maricopa County. It was found that these source profiles could explain the Maricopa County air quality data reasonably well. In addition, these applications indicated that the relative importance of emission sources was similar to the ranking for the Denver area.

Six control measures are recommended by this study to decrease emissions contributing to the brown cloud. Many control measures implemented to comply with Federal air quality regulations for carbon monoxide, ozone, and particulate matter will also reduce emissions that contribute to brown clouds. The six recommended measures were chosen because they were not being implemented by other programs, and would directly control those pollution sources most responsible for the brown cloud. The six recommended measures would need to be further evaluated for feasibility by the respective implementing entities.

It is important to note that the 1999 Brown Cloud Project is not intended as a State Implementation Plan revision for any air pollutant including $PM_{10}$ and $PM_{2.5}$.

## ES.2 BACKGROUND INFORMATION ON URBAN BROWN CLOUDS

Brown clouds occur over most urban areas in the western United States. Brown clouds are hazes with a brown appearance. Haze is a suspension in the atmosphere of minute particles that are not individually seen but, nevertheless, impair visibility. These particles are called particulate matter, or PM. The dominant cause of haze in urban areas is light scattering by particles with a diameter less than 2.5 micrometers. These particles are called fine particles or $PM_{2.5}$.

The hazes appear brown because of light absorption by elemental carbon, which has a chemical form similar to the graphite used in pencil leads. The days when brown clouds occur are determined by the weather. Brown clouds occur on calm mornings during fall and winter when the cool air near the ground forms a stable layer that traps emissions near the surface.

The dominant source of $PM_{2.5}$ is combustion sources, primarily gasoline and diesel engine exhaust. Decreasing the amount of elemental carbon in brown clouds will decrease the dark or brown appearance of the haze and may be visually rewarding. Decreasing other components will improve the visibility through the haze. Because elemental carbon absorbs light very efficiently and contributes to the dark appearance of brown clouds, the control strategies recommended place greatest emphasis on decreasing the emissions of elemental carbon.

The new PM standards were published by the EPA Administrator in July 1997. These standards place limits on the concentrations of both $PM_{2.5}$ and $PM_{10}$. However, on May 14, 1999, a three-judge panel of the U.S. Court of Appeals for the District of Columbia Circuit issued a split opinion regarding the final national air quality standards for ozone and particulate matter that the Environmental Protection Agency promulgated in July 1997. With respect to the particulate matter standards, the Court vacated the revised coarse particle ($PM_{10}$) standards, and the pre-existing $PM_{10}$ standard continues to apply.

Regarding the PM-2.5 standard, the Court upheld EPA's decision to rely on the regional haze program to mitigate some of the adverse visibility effects caused by PM-2.5. The Court also asked for further briefing on several issues. On June 18, 1999, the Court ruled that the $PM_{2.5}$ standard should remain in place. However, the Court will allow parties to apply for the standard to be vacated if "the presence of this standard threatens a more imminent harm." Presumably, the "harm" refers to the burden on sources complying with the regulations.

On June 28, 1999, EPA and the Department of Justice filed a petition for rehearing en banc with the D.C. Circuit. In its October 29, 1999 ruling, the U.S. Court of Appeals for the District of Columbia Circuit denied EPA's request for a rehearing of its May 14, 1999 decision. EPA continues to support the need for the health protections that these revised standards provide as well as the science backing them.

## ES.3 URBAN BROWN CLOUDS IN MARICOPA COUNTY

Airport visibility observations provide an indication of a decrease in regional haze in Maricopa County, but for reasons discussed in the report, do not provide information about trends in brown clouds in Maricopa County.

Starting in December 1993, the Arizona Department of Environmental Quality (ADEQ) began measuring light extinction over a 3-mile sight path in Phoenix. The data provide a measure of the severity of the brown clouds and indicate that the haze in Phoenix is highly variable. Severe hazes mostly occur from late September through February and rarely occur during the spring or summer. During the fall and winter, the weather may cause the air to be clear or very hazy at any time of day.

Soil dust is mostly composed of particles too large to scatter light efficiently. About half of the PM in Maricopa County is soil dust, but this dust is typically

responsible for less than 10 percent of the light scattering that causes brown clouds. Elemental carbon absorbs light very efficiently. Light absorption by elemental carbon is primarily responsible for the dark or brown appearance of most urban hazes. Ambient measurements show that roughly two-thirds of the $PM_{2.5}$ is carbon-related and about one-third of the carbon component is elemental carbon. Other contributors to visibility reduction include sulfates and nitrates.

## ES.4 IMPORTANT SOURCES

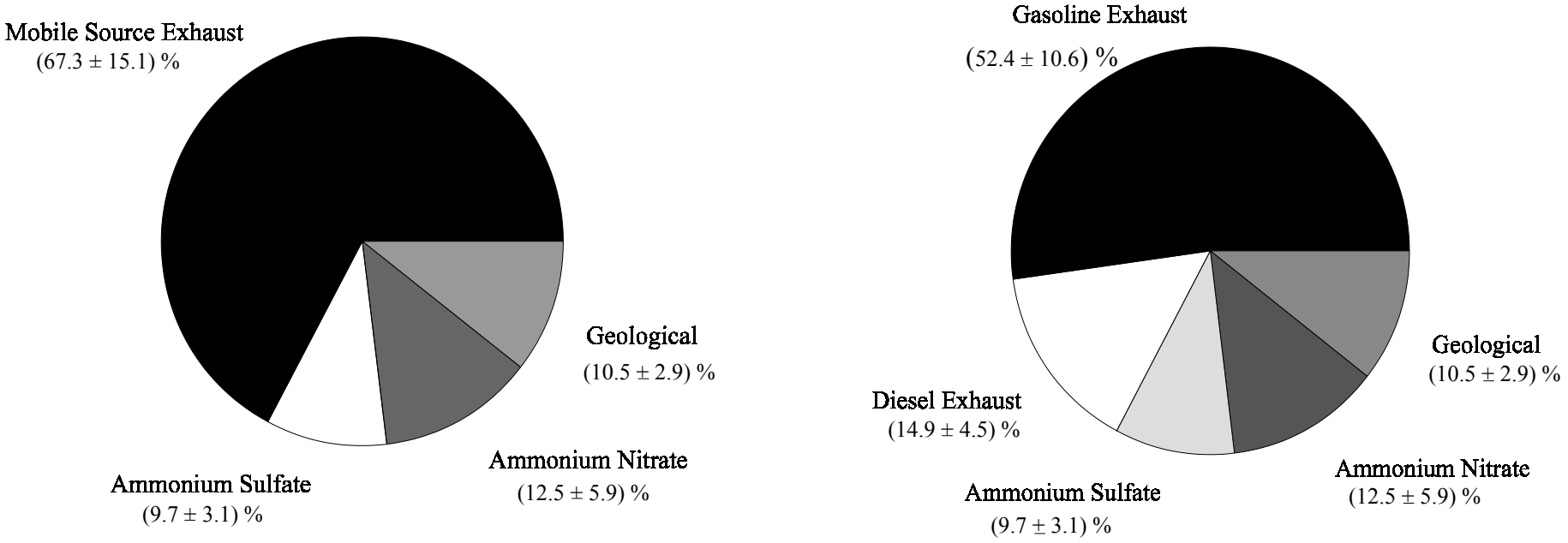
Information on the emission sources in Maricopa County that make the largest contributions to brown clouds was derived from chemical mass balance (CMB) calculations performed during this study and as part of the 1989-1990 Phoenix $PM_{10}$ Study and the 1989-1990 Phoenix Urban Haze Study. Briefly, CMB is a mathematical method that finds the combination of emission sources that best accounts for the pollutant concentrations measured in the atmosphere at the time and location where a pollution sample was collected. The emission inventory information contained in the MAG 1999 Serious Area Particulate Plan for $PM_{10}$ for the Maricopa County Nonattainment Area was also used. These two types of information on emission sources were used to identify sources that make the largest contribution to brown clouds.

In addition, a series of sensitivity tests and reasonableness checks were performed on the CMB data, and the results are presented in Appendix E. The sensitivity tests indicated that the source apportionments depend on the source profile selection and that other source attributions with acceptable statistics may be obtained from the same data set using different combinations of source profiles. The CMB statistics indicate how well each selected set of source profiles explains the ambient data. The amount by which the source apportionments obtained using different sets of source profiles differ from each other provides a measure of the uncertainties in CMB analyses that arise from the selection of source profiles. Because this source of uncertainty is not addressed in the CMB statistics, the overall uncertainty in the results from CMB analyses is larger than indicated by the CMB statistics alone. The CMB results from this study provide a general understanding of the relative importance of different sources that contribute to the Brown Cloud.

As shown in Figure ES-1, combustion sources emissions constitute the majority of $PM_{2.5}$. Gasoline engine exhaust accounts for about half of the ambient $PM_{2.5}$ and diesel engine exhaust accounts for about 15 percent. In addition, gasoline and diesel exhaust account for nearly all of the carbonaceous fraction of the fine particles (organic carbon and elemental carbon). The CMB results indicate that gasoline and diesel vehicles contribute similar amounts of the elemental carbon. Of the gasoline-engine exhaust component of the $PM_{2.5}$ , a disproportional large contribution comes from cold starts and high emitters. Although this result is uncertain, it is important to examine these sources further and to recognize that the suggested controls will help reduce emissions from these sources.

When interpreting the results from the CMB analysis, it is important to keep in mind the limitations of the model and view the results as the general level of contributions from a source.

Figure ES-1. PM-2.5 source contributions from the CMB analysis of samples from the Phoenix Super Site (The data in the parenthesis represent the mean percentage and standard error calculated at 95% confidence).




Note: The lack of source profiles in the CMB analysis for wood burning and meat cooking likely results in an overestimate of the emissions from diesel and gasoline-powered engines. The contribution from gasoline-powered engines is likely to be overestimated to a greater extent than the contribution from diesel-powered engines.

The results presented have different levels of confidence associated with them. For example, there is a relatively high level of confidence in estimates for the contribution of total mobile source exhaust, ammonium nitrate, ammonium sulfate, and geological material. There is a lower level of confidence associated with the split in mobile source exhaust between diesel-powered engines and gasoline-powered engines. There is also lower confidence that the CMB attribution of gasoline-powered engines emissions to cold start, high emitter, and hot stabilized is accurate.

## ES.5 CONTROL MEASURES TO REDUCE THE BROWN CLOUD

Based on literature reviews, interviews, and research done to complete the Serious Area $PM_{10}$ Plan, the study team identified over 40 candidate brown cloud control measures. The candidate measures were screened using factors such as technical feasibility, ability to augment existing programs, and applicability to important brown cloud sources. In addition, the committed control measures from the State and local governments in the MAG 1999 Serious Area Particulate Plan for $PM_{10}$ were applied to the appropriate source categories to identify where additional control measures were needed. Six measures were recommended for consideration because they were not being implemented by other programs and would directly control those pollution sources most responsible for the brown cloud. These recommended measures would need to be further evaluated for feasibility by the respective implementing entities.

One of the steps in the control measure identification and screening process involved identifying existing Maricopa County control measures that will mitigate the brown cloud. The effort focused on reviewing committed measures from the State and local governments in the MAG 1999 Serious Area Particulate Plan for $PM_{10}$ and previous plans. **Tables ES-1 and ES-2** summarize both Federal actions and State and local government measures by source category. Table ES-1 addresses the most important brown cloud combustion sources, which include: nonroad mobile diesel exhaust and onroad mobile diesel and gasoline exhaust. Table ES-2 lists several control measures that offer only minor brown cloud control benefits. They are included in this report to illustrate particulate matter air quality control efforts already underway in the Maricopa County area.

Table ES-2 addresses sources of dust. As detailed in the Serious Areas $PM_{10}$ Plan, dust is the single most important component of the Maricopa County $PM_{10}$ problem. Although dust is not a major contributor to brown clouds, dust controls do provide some modest brown cloud mitigation benefits. The dust control measures are presented in this report to illustrate particulate matter air quality control efforts already underway in the Maricopa County area.

The overall control strategy focused on reducing nonroad and onroad diesel emissions, and reducing emissions from high PM-emitting onroad gasoline powered vehicles. Mobile source control measures fall into four categories: establishing more stringent new-vehicle standards; retrofitting and replacing older vehicles; reformulating the fuels used; and restricting or changing the use of the vehicle or engine. These four control measure approaches directly reflect the parameters controlling the amount of pollution produced by mobile sources. Table ES-3 briefly highlights how these parameters and control measure approaches relate to the important sources contributing to the brown cloud. The table identifies important sources, important pollution parameters for each source, and how the

recommended measures relate to the parameters responsible for pollution to create the brown cloud.

The six recommended brown cloud control measures include:

1. Mandating the use of a clean burning diesel fuel.

Reformulating diesel fuel to reduce emissions from onroad vehicles and nonroad diesel-powered equipment.

2. Encouraging retrofits and replacements of nonroad diesel engines and equipment.

Retrofitting or replacing older, more polluting nonroad diesel equipment, especially construction equipment, to reduce exhaust emissions.

3. Strengthening the voluntary onroad diesel vehicle retirement program.

Strengthening existing programs to encourage early retirement of higher polluting onroad heavy-duty diesel vehicles.

4. Electrifying truck stops through a pilot program.

Implementing a pilot program to demonstrate the feasibility of reducing heavy-duty diesel vehicles idling through truck stop electrification.

5. Implementing a toll-free telephone number for smoking vehicle complaints.

Strengthening current Maricopa County programs by implementing a toll-free telephone number to help the public report smoking vehicles. The toll-free number could facilitate follow-up notifications to vehicle owners to have their vehicle inspected at an inspection and maintenance (IM) facility.

6. Implementing a smoking vehicle identification and citation program.

Operating a smoking vehicle identification program to identify and send written notices to smoking vehicles, requiring the vehicle to be inspected at an IM facility.

In addition to the six recommended measures, two additional measures are suggested for further study. These measures include:

- Implementing the use of remote sensing devices (RSDs) capable of detecting smoking vehicles.
- Implementing an IM program enhancement to detect or test for smoking vehicles or particulate matter high emitters.

## ES.5 PUBLIC PARTICIPATION

The process used to develop the 1999 Brown Cloud Project included meetings of the MAG Air Quality Technical Advisory Committee, MAG Management Committee, and MAG Regional Council. All of these meetings were open to public attendance. In addition, a public workshop was conducted on October 25, 1999 to solicit additional citizen input during the preparation of the 1999 Brown Cloud Project. The workshop notice and response to public comments are contained in Appendix H.

On November 10, 1999, the MAG Air Quality Technical Advisory Committee recommended approval of the 1999 Brown Cloud Project for the MAG area and requested that potential implementing entities consider the control measures for implementation, if feasible. The MAG Management Committee concurred with this

recommendation on November 17, 1999. Additional comments were received following the MAG Management Committee meeting and are addressed in Appendix H. On December 8, 1999 the MAG Regional Council approved the 1999 Brown Cloud Project for the MAG Area and requested that the potential implementing entities consider the recommended measures for implementation, if feasible.

Table ES-1. Important brown cloud sources, major federal actions, state and local government measures and potential additional control measure opportunities. Information is organized to reflect the four major control strategies available to reduce mobile source emissions: exhaust standards for new engines and vehicles, fuel changes, vehicle inspection and maintenance (I/M), and use management.

| Source Category and Sources | Federal Actions | State and Local Government Measures for the Maricopa County Area | Opportunities for Additional Control |
|---|---|---|---|
| | | | |
| I. Nonroad Mobile Sources – diesel | 1. Exhaust Standards: October 23, 1998: EPA final rulemaking to reduce emissions from nonroad diesel engines. Rule establishes standards (stds) for virtually all nonroad equipment; the new stds would phase in from 1999-2008, depending upon equipment types. Standards would achieve approximately a 34% reduction in PM emissions by 2010, and a 45% reduction by 2020 (Environmental Protection Agency, 1998; Preamble, Table 6).<br>2. Fuel: none.<br>3. I/M: none.<br>4. Use Management: none | Exhaust Standards: Off Road Vehicle Engine Standards<br><br>Fuel: Limit Sulfur Content of Diesel Fuel Oil to 500 ppm<br><br>Diesel Fuel Sampling and Reporting<br><br>I/M: none.<br><br>Use Management: Encourage the Use of Temporary Electrical Power Lines Rather than Portable Generators at Construction Sites | 1. Exhaust Standards: Encourage retrofits of existing equipment with more effective exhaust control technology.<br>2. Fuel: (a) provide tax incentives, low interest loans, and/or rebates to retrofit diesel equipment with alternative fuel capability (CNG/LNG), or to purchase new alternative fueled or cleaner operating equipment; (b) explore potential fuel reformulations, such as:<br>• lowering sulfur content;<br>• lowering aromatics, as with California diesel (may generate a 10% reduction in PM); lowering aromatics lowers soot emissions (STAPPA and ALAPCO, 1996; p. 105);<br>• raising cetane level of fuel provides potential PM reductions of up to 12% (NESCAUM, 1997; p. IX-22);<br>• adding oxygenates (e.g., water, alcohols, or ethers); a 2% oxygen content may generate 8 to 15% reductions in PM; 5% oxygen may reduce PM by 20% (NESCAUM,1997; p. VIII-5). Note: the only commercially available oxygenated diesel sold in the U.S. is biodiesel, sold in small volume in the northeast U.S., in part due to its higher cost (Oxy-Fuel News, 1997).<br>3. I/M: encourage EPA to develop in-use compliance testing program.<br>4. Use Management: Encourage use of low-emitting equipment through (a) contractor award criteria for government-sponsored construction projects; and/or (b) emission budget and trading approach for nonroad sources. |

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| Source Category | Federal Actions | State and Local Government Measures for the Maricopa County Area | Opportunities for Additional Control |
|---|---|---|---|
| | | | |
| Onroad Mobile Sources - diesel exhaust | 1. Exhaust Standards:<br>• December 21, 1999: EPA Notice of Final Rulemaking for Tier 2 Motor Vehicle Emission Standards included fuel-neutral Tier 2 standards for the **light-duty** market which applies the standards equally to gasoline and diesel powered vehicles. Tier 2 standards are proposed to be phased-in between 2004 and 2009.<br>• October 6, 1999: EPA Regulatory Announcement for a Proposed Strategy to Reduce Emissions from Heavy Duty Vehicles, including diesel and gasoline engines used in large commercial trucks, larger versions of full-size pickup trucks, passenger vans, and the largest sport utility vehicles. The first phase would require gasoline trucks to be 78 percent cleaner and diesel trucks to be 50 percent cleaner than today's models. The first phase would take effect starting with the 2004 model year. In late 1999, EPA anticipates proposing a second phase to propose even more stringent standards that could take effect as early as 2007 to reduce Nox emissions by between 75 and 90 percent beyond phase one. Emissions of particulate matter could be reduced by 80 to 90 percent.<br>• New and retrofit trucks and urban bus standards phased-in 1991-1994; reduce PM emissions more than 80% in affected vehicles; reductions will continue to accrue as fleet turns over. [Note that in October 1997, EPA announced more stringent $NO_x$ and hydrocarbon (HC) emissions standards for diesel trucks and buses; the new standards do not affect directly emitted PM.] | Exhaust Standards: Require Pre-1988 Heavy-Duty Diesel Commercial Vehicles Registered in the Nonattainment Area to Meet 1988 Federal Emission Standards; Provide Incentives to Encourage Voluntary Accelerated Vehicle Replacement by the Year 2004<br><br>Fuel: Limit Sulfur Content of Diesel Fuel Oil to 500 ppm<br><br>Diesel Fuel Sampling and Reporting<br><br>Alternative Fuel Vehicles for Local Governments and School Districts, and Federal Government/Low Emission Vehicle Requirements<br><br>I/M: Voluntary Vehicle Repair and Retrofit Program<br><br>Random Roadside Testing of Diesel Vehicles<br><br>Snap Acceleration Test for Heavy-Duty Diesel<br><br>Oxidation Catalyst for Heavy Duty Diesel Vehicles<br><br>Use Management: Coordinate Traffic Signal Systems<br><br>Develop Intelligent Transportation Systems | 1. Exhaust Standards: (a) Implement voluntary low emission standards, with emission reduction credits as an incentive (based on SCAQMD program) (NESCAUM, 1997; p. X-11).<br>(b) encourage retrofitting of existing vehicles.<br>(continued) |

| Source Category | Federal Actions | State and Local Government Measures for the Maricopa County Area | Opportunities for Additional Control |
|---|---|---|---|
| | 2. Fuel:<br>• May 13, 1999: EPA Advance Notice of Proposed Rulemaking for Control of Diesel Fuel Quality indicated that new quality requirements for fuel used in diesel engines is being considered to bring about large environmental benefits through the enabling of a new generation of diesel emission control technologies. The most promising change would be desulfurization to enable the new engine and after treatment technologies that are currently sensitive to sulfur. These advanced sulfur-sensitive technologies have the potential to reduce diesel engine Nox emissions by up to 75 percent and PM emissions by 80 percent or more.<br>• October 6, 1999: EPA Regulatory Announcement for a Proposed Strategy to Reduce Emissions from Heavy Duty Vehicles with a gross vehicle weight rating greater than 8,500 pounds, including diesel and gasoline engines, indicated that EPA intends to propose a second phase in late 1999 which would involve reducing the sulfur content of highway diesel fuel by 90 percent from its current level of 500 ppm. The second phase could take effect as early as 2007.<br>• beginning in October 1993, diesel fuel had to be low sulfur (500 ppm), and have either a 35% maximum aromatics level or a minimum cetane index of 40; EPA estimates that PM emissions are reduced by 90% due to low sulfur fuel (NESCAUM, 1997; p. VIII-2).<br>3. I/M: none.<br>4. Use Management: none. | | 2. Fuel: (a) Continuing to promote the use of alternative fuels. (b) Reformulate diesel fuel to reduce elemental carbon emissions (see discussion above for off-road equipment).<br>3. I/M: Supplementing the region's existing HDDV inspection and maintenance program, by either (a) expanding the program's geographic scope, (b) conducting random roadside testing, as is being implemented in California in 1998 (voluntary or mandatory; mandatory currently prohibited under SB 1002).<br>4. Use Management: Limit vehicle idling |

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| Source Category | Federal Actions | State and Local Government Measures for the Maricopa County Area | Opportunities for Additional Control |
|---|---|---|---|
| Onroad Mobile Sources - gasoline exhaust | Exhaust Standards: December 21, 1999: EPA Notice of Final Rulemaking for Tier 2 Motor Vehicle Emission Standards included fuel-neutral Tier 2 standards for the **light-duty** market which applies the standards equally to gasoline and diesel powered vehicles. Tier 2 standards are proposed to be phased-in between 2004 and 2009.<br><br>Fuel: December 21, 1999: EPA Notice of Final Rulemaking for Tier 2 Motor Vehicle Emission Standards also included a phased-in program to ultimately reduce the sulfur in gasoline by establishing an average sulfur level of 30 ppm with a maximum cap of 80 ppm in 2006. The phases begin in 2004 with a cap of 300 ppm and annual average sulfur level of 120 ppm. In 2005, the refinery average will be 30 ppm, with a corporate average of 90 ppm and a cap of 300 ppm. In the notice, EPA indicates that reductions in gasoline sulfur levels would reduce PM emissions from gasoline vehicles.<br><br>I/M: No programs targeted to "gross" or high PM emitters. In general, enhanced I/M requirements applicable in the MAG area, along with fleet turnover, will contribute to vehicle retirement and maintenance. | Exhaust Standards: National Low Emissions Vehicle Program<br><br>Fuel: Winter Fuel Reformulation: California Phase 2 Reformulated Gasoline with 3.5 Percent Oxygen Content November 1 through March 31<br><br>Alternative Fuel Vehicles for Local Governments and School Districts, and Federal Government/Low Emission Vehicle Requirements<br><br>Alternative Fuel Vehicles for State Government/Low Emission Vehicle Requirements<br><br>Alternative Fuel Vehicle and Equipment Tax Incentives/Low Emission Vehicle Requirements<br><br>Public Awareness Program for Alternative Fuels<br><br>Alternative Fuels for Fleets<br><br>I/M: Tougher Enforcement of Vehicle Registration and Emission Tests<br><br>Catalytic Converter Replacement Program<br><br>One-Time Waiver from Vehicle Emissions Test<br><br>Phased-In Emission Test Cutpoints<br><br>Enhanced Emission Testing of Constant Four-Wheel Drive Vehicles<br><br>Increased Waiver Repair Limit Options<br><br>Gross Polluter Option for I/M Program Waivers<br><br>Vehicle Repair Grant Program | 1. Exhaust Standards: none.<br>2. Fuel: none.<br>3. I/M: (a) Expand the enhanced I/M program to include more stringent pass/fail standards and a broader geographic scope. (b) Explore with California officials the appropriateness of using the California HEP program. (c) Encourage early vehicle retirement by identifying gross emitters through the existing I/M and remote sensing programs.<br>4. Use Management: Change the Smoking Vehicle Hotline to a toll free number, and link publicity about the new number to a public outreach campaign tied to forecasting Brown Cloud problems. |

| Source Category | Federal Actions | State and Local Government Measures for the Maricopa County Area | Opportunities for Additional Control |
|---|---|---|---|
| | | Voluntary Vehicle Repair and Retrofit Program<br><br>Voluntary Gasoline Vehicle Retirement Program/Maricopa County Travel Reduction Program<br><br>Expansion of Area A Boundaries<br><br>Remote Sensing<br><br><u>Use Management</u>: Coordinate Traffic Signal Systems<br><br>Mass Transit Alternatives<br><br>Develop Intelligent Transportation Systems<br><br>Special Event Controls - Required Implementation from List of Approved Strategies<br><br>Encourage Limitations on Vehicle Idling<br><br>Voluntary No-Drive Days<br><br>Expansion of Public Transportation Programs<br><br>Employer Rideshare Program Incentives<br><br>Preferential Parking for Carpools and Vanpools<br><br>Reduce Traffic Congestion at Major Intersections<br><br>Site-Specific Transportation Control Measures<br><br>Encouragement of Bicycle Travel<br><br>Development of Bicycle Travel Facilities<br><br>Alternative Work Schedules<br><br>Land Use/Development Alternatives<br><br>Encouragement of Pedestrian Travel | |

| Source Category | Federal Actions | State and Local Government Measures for the Maricopa County Area | Opportunities for Additional Control |
|---|---|---|---|
| | | Areawide Public Awareness Programs<br><br>Encouragement of Vanpooling<br><br>Trip Reduction Program<br><br>Park and Ride Lots<br><br>Encouragement of Telecommuting, Teleworking, and Teleconferencing<br><br>Promotion of High Occupancy Vehicle (HOV) Lanes and By-Pass Ramps | |

Table ES-2. Minor brown cloud sources, state and local government measures.

| Source Category and Sources | State and Local Government Measures for the Maricopa County Area |
|---|---|
| | |
| I. Nonroad Mobile Sources – gasoline | Exhaust Standards: Off Road Vehicle Engine Standards<br><br>Fuel: Winter Fuel Reformulation: California Phase 2 Reformulated Gasoline with 3.5 Percent Oxygen Content November 1 through March 31<br><br>I/M: none.<br><br>Use Management: Encourage the Use of Temporary Electrical Power Lines Rather than Portable Generators at Construction Sites<br><br>Voluntary Lawn Mower Emissions Reduction Program<br><br>Restrictions on the Use of Gasoline-Powered Blowers for Landscaping Maintenance |
| Area Sources | Restaurant Charbroiler Controls<br><br>PM-10 Episode Thresholds<br><br>Clean Burning fireplace Ordinance<br><br>Public Information Program on Wood Stoves and Wood Heat |
| Point Sources | PM-10 Best Available Control Technology (BACT) Determinations for Stationary Sources |

Table ES-2. Minor brown cloud sources, state and local government measures.

| Source Category | State and Local Government Measures for the Maricopa County Area |
|---|---|
| | |
| Fine Soil Dust - Fugitive/Windblown | PM-10 Efficient Street Sweepers<br><br>Curbing, Paving, or Stabilizing Shoulders on Paved Roads (Includes Painting Stripe on Outside of Travel Lane)<br><br>Paving, Vegetating and Chemically Stabilizing Unpaved Access Points Onto Paved Roads (Especially Adjacent to Construction/Industrial Sites)<br><br>Reduce Particulate Emissions from Unpaved Shoulders on Targeted Arterials<br><br>Crack Seal Equipment<br><br>Frequent Routine Sweeping or Cleaning of Paved Roads<br><br>Strengthening and Better Enforcement of Fugitive Dust Control Rules*<br><br>Reduce Particulate Emissions from Unpaved Roads and Alleys<br><br>Low Speed Limit for Unpaved Roads<br><br>Use of Petroleum Products for Public Road and Street Maintenance<br><br>Agricultural Best Management Practices<br><br>Additional Dust Control Measures (City of Tempe)<br><br>Additional Dust Control Measures (City of Phoenix) |

* Includes:

2. Reduce Particulate Emissions from Unpaved Parking Lots
3. Reduce Particulate Emissions from Vacant Disturbed Lots
4. Dust Control Plans for Construction/Land Clearing and Industrial Sites (Including Active landfills), with Elements Addressing Trackout Prevention, Site and Material Maintenance, Construction Staging, and High Wind Operating Restrictions
5. Dust Abatement and Management Plans for State Lands.

Table ES-3. Important brown cloud sources, source parameters, and recommended controls.

| Source Category and Sources | Source Parameters | Recommended Brown Cloud Controls | Brief Control Measure Comments |
|---|---|---|---|
| | | | |
| Nonroad Mobile Sources - diesel exhaust | Diesel engine design<br>Diesel engine maintenance practices<br>Diesel fuel specifications<br>Hours of use (time of day and total hours) | • Retrofit and replacement of nonroad equipment<br>• Clean burning diesel fuel | Recommended measures address engine design and maintenance and fuel specifications. Implementing a clean burning diesel fuel is an effective way to reduce emissions from both nonroad and onroad diesel-powered engines. Encouraging replacements complements new EPA standards for nonroad engines; the standards phase-in between 1999 and 2008. Use restrictions would be difficult to enforce given the broad array of equipment in the nonroad category. |
| | | | |
| Onroad Mobile Sources - diesel exhaust | Diesel engine design<br>Diesel engine maintenance practices<br>Diesel fuel specifications<br>Vehicle miles traveled (VMT)<br>Hours of use (including idling time) | • Retirement of onroad diesel vehicles<br>• Clean burning diesel fuel<br>• Electrify truck stops | Recommended measures address engine design and maintenance, fuel specifications, and hours of use. Implementing a clean burning diesel fuel is an effective way to reduce emissions from both nonroad and onroad diesel-powered engines. Encouraging replacements complements more stringent PM emissions standards, which began in 1991. Driving and idling restrictions are difficult to enforce. Programs to reduce idling may become more practical if the pilot program to electrify heavy-duty vehicle stops produces useful information. |
| Onroad Mobile Sources - gasoline exhaust | Engine oil consumption<br>Vehicle maintenance practices<br>Engine operation (rich or lean)<br>VMT | • Toll-free number for smoking vehicles<br>• Smoking vehicle identification and citation program | Recommended measures address oil consumption and vehicle maintenance/engine operation. Smoking vehicle identification programs identify high PM-emitting vehicles and encourage maintenance and repair work to reduce emissions. VMT restrictions are difficult to enforce, particularly since smoking vehicles are difficult to identify. |